

Notice of Oral Ex Parte Presentation

April 4, 2005

Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: In the Matter of
Unlicensed Operation in the 3650-3700 MHz, ET Docket No. 04-151;
Additional Spectrum for Unlicensed Devices below 900 MHz and the 3
GHz Band, ET Docket No. 02-380; and Amendment of the Commission's Rules with
Regard to the 3650-3700 MHz Government Transfer Band, ET Docket No. 98-237.

On April, 2005, Duane Buddrius representing Alvarion, Mariana Goldhamer representing the IEEE 802.16 LE task group and Patrick Leary representing the WiMAX regulatory work group (with permission) met with approximately 15 members of the OET and WTB in an open presentation session. The purpose of the discussion and presentations were to gain understanding of the FCC's intent of the contention based requirement as well as to inform the FCC of issues related to such requirement. These issues stem around the abilities of next generation wireless broadband systems being able to offer the QoS being demanded by the market in order to compete with wire based solutions, and yet still be cognizant of other wireless systems and share the spectrum. The Power Point Presentations provided as attachment to this filing detail these discussion points from the perspective of a vendor, standards organization, and industry forum in order to offer the broadest view of the problems and possible technical solutions. No specific position was taken as part of this meeting, just open discussion for better understanding.

Pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. § 1.1206, hard copy of this submission has been provided to the participants of the meeting. Please contact the undersigned with any questions in connection with this filing.

Sincerely,

/S/

Duane Buddrius
Director of Product Engineering & Product Management
Alvarion, Inc.
2495 Leghorn Street
Mountain View, CA 94043

MEETING WITH FCC

APRIL 4, 2005

WiMAX Forum – Patrick Leary

Alvarion – Duane Buddrius

IEEE 802.16h & LE TG – Mariana Goldhamer



FCC 3650-3700MHz Meeting WiMAX Forum Update & Regulatory Positions

Presenter: Patrick Leary, AVP Marketing, Alvarion
Date: April 4, 2005

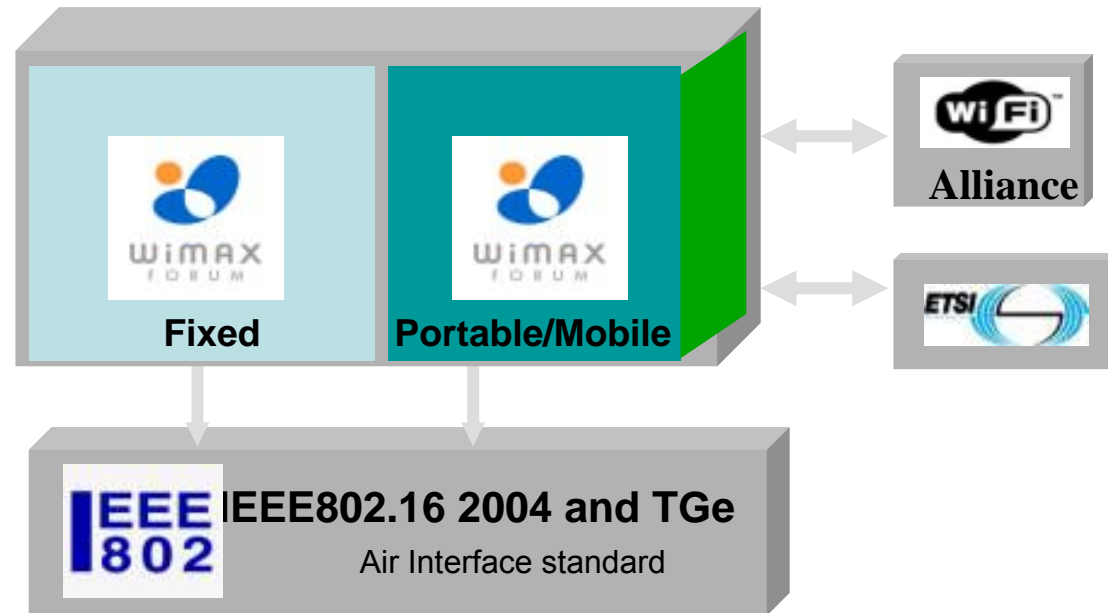
Agenda

- WiMAX Forum Update
- Wireless Broadband Industry Update
- WiMAX Market Opportunity
- WiMAX Operators Demands
- WiMAX Forum Regulatory Vision
- WiMAX View on 3650MHz
- Summary

WiMAX Forum Update

WiMAX Forum Vision

- Create a global mass market for deployment of broadband wireless networks, that will enable fix, portable and mobile users to maintain high-speed connectivity.
- To lead the “access anywhere” revolution supporting delivery of data, voice and video applications at home, in the office and on the go.



Membership Update

- Approximately 250 members, including global leading companies along every link in the technology/telecom supply chain:
 - E.g. Intel, Samsung, Sanyo, Cisco, Dell, Juniper, Lucent, Alcatel, Nokia, Alvarion, Motorola, ZTE, AT&T, SBC, British Telecom, France Telecom, Deutsche Telecom, Time Warner Telecom, The Walt Disney Company

Certification Update

- CETECOM in Spain chosen as the first lab site for certification testing.
- Currently finishing testing protocols and lab customization for WiMAX.
- On schedule for late June/early July “plugfest” testing.
- Alvarion, Airspan, and Redline announced pre-certification interoperability testing.
- Intel Rosedale chip nearing commercial production.

What Equipment Does Certification Cover?

- Certification provided to equipment (Base Station and Subscriber or CPE), not to components (silicon, RF, software...)
- Certified equipment can use “WiMAX Forum CERTIFIED” text and logo
- “WiMAX Forum CERTIFIED” is Trademarked



WiMAX Interoperability

- Based upon market requirements, reduce the breadth of the standard so that baseline interoperability can be achieved between vendors
 - Multi-vendor process to create Certification tests
 - Based upon ISO/IEC 9646 process
- Cetecom Spain is the official certification laboratory (many branch labs around the world)
- Equivalent in purpose to Wi-Fi Alliance* for 802.11 or Cablelabs* for DOCSIS
- Worldwide recognized WiMAX-Certified stamp of approval

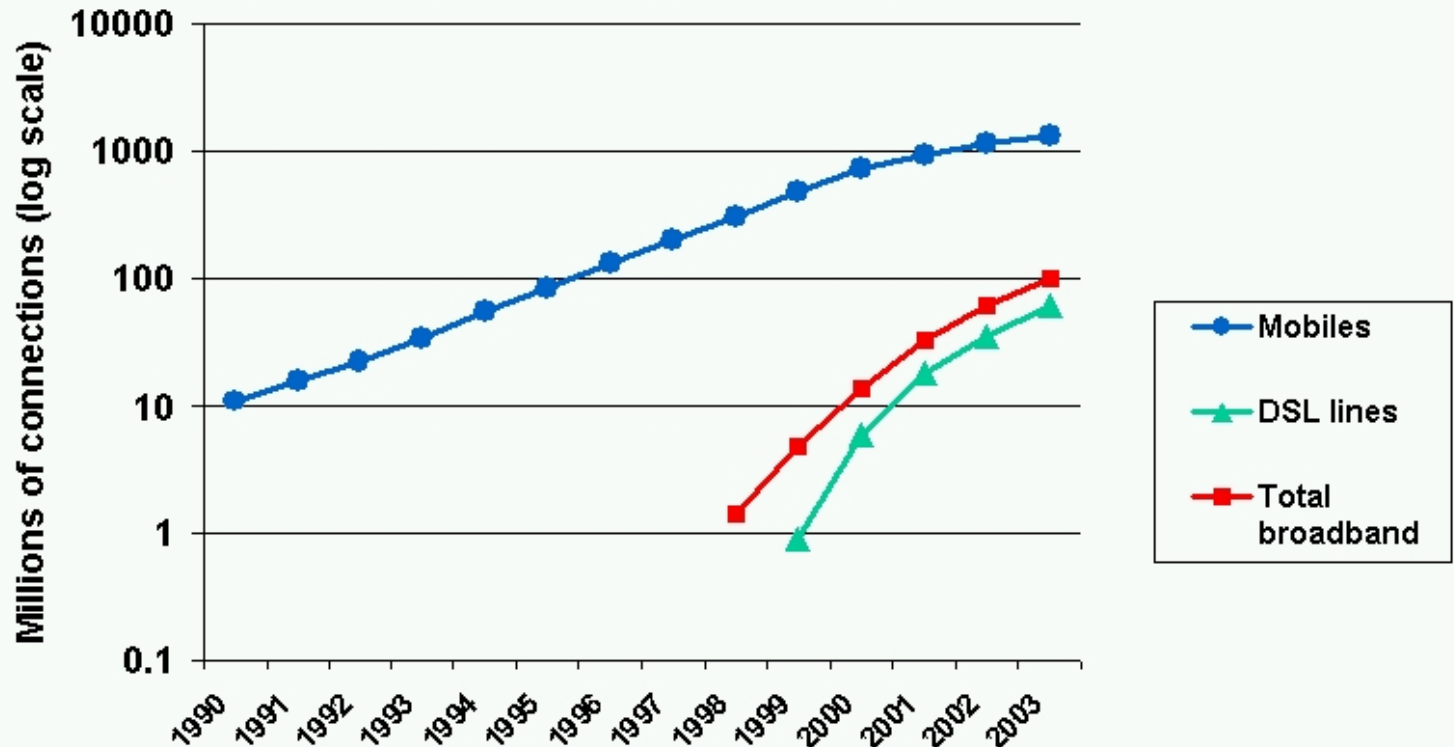
WiMAX Forum Working Groups

- Regulatory Working Group (RWG)
- Service Provider Working Group (SPWG)
- Technical Working Group (TWG)
- Certification Working Group (CWG)
- Marketing Working Group (MWG)
- Applications Working Group (AWG)

Industry Update

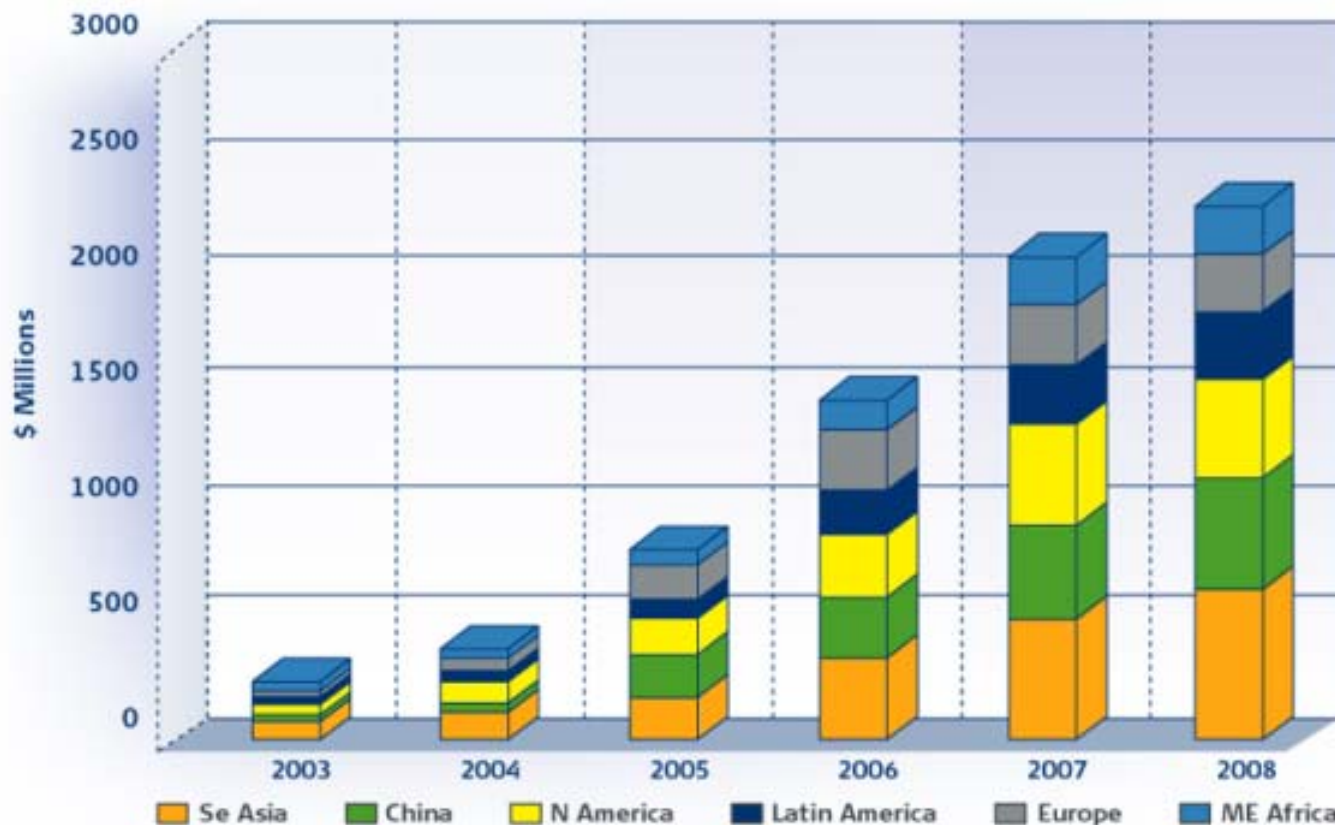
Worldwide Broadband Market Growth

- Broadband Growth rate exceeding Mobile Growth



BWA Market Growth-Fixed Wireless Only

Worldwide Broadband Wireless Equipment Revenue < 10GHz



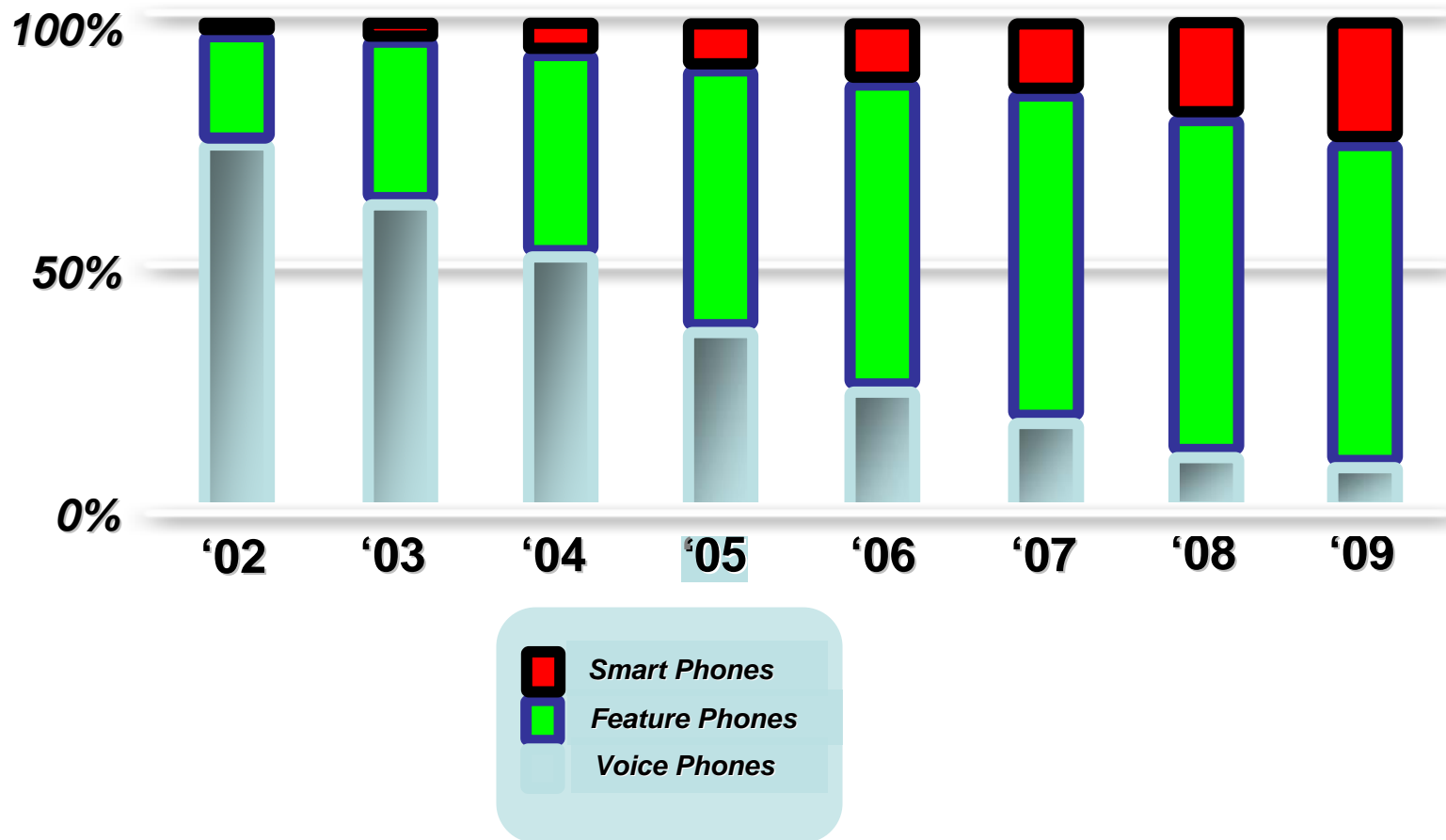
\$305M in 2003 → \$2.9B in 2008 = 5 yr CAGR of 52.2%

Source: Sky Light Research 2004

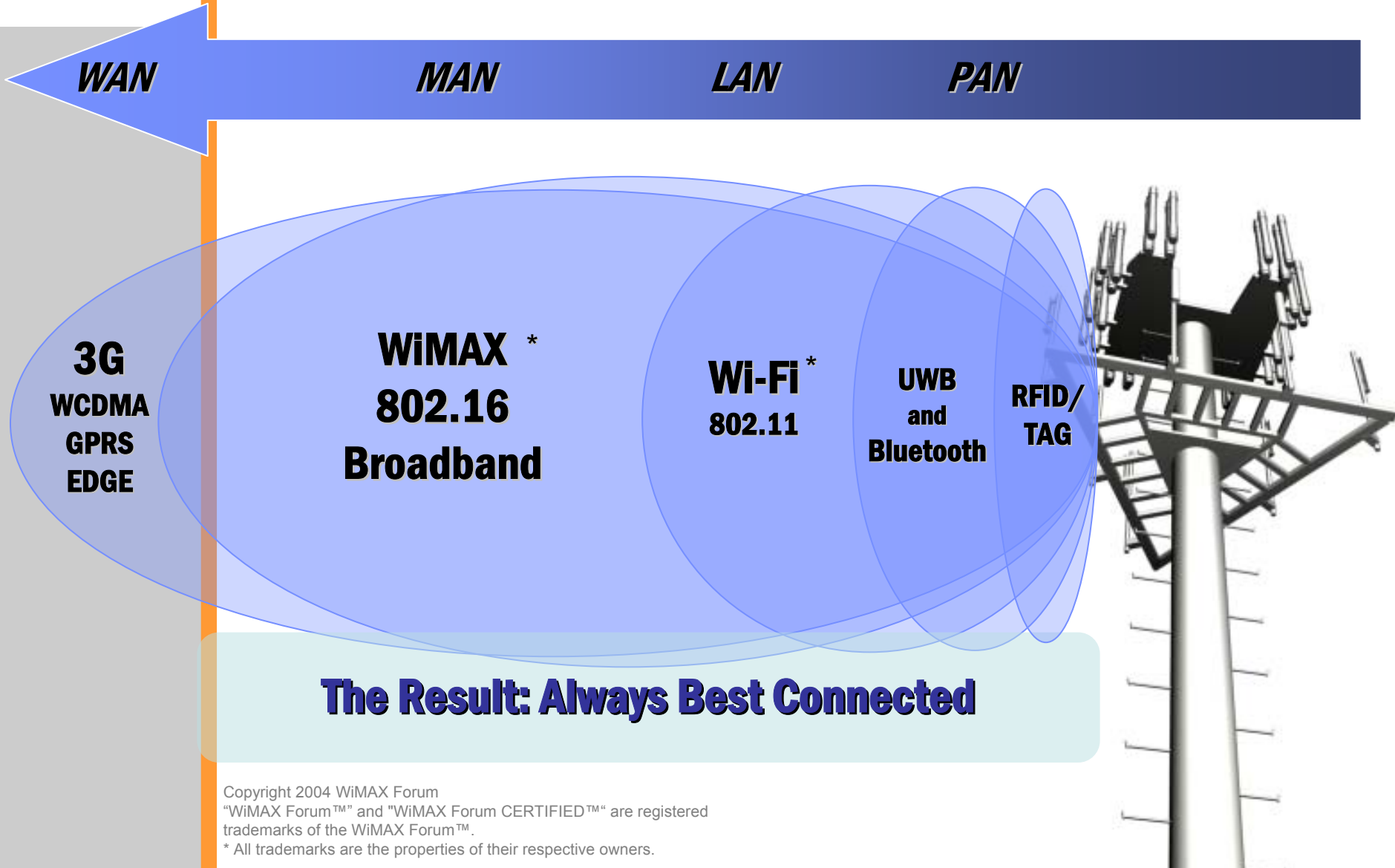
Data-Centric Phone Shipments Overtake Voice-Centric Phones in '05

Voice Revenues Growing at a 4.7% CAGR

Data Revenues Growing at a 30.7% CAGR



Wireless Technologies are Complementary



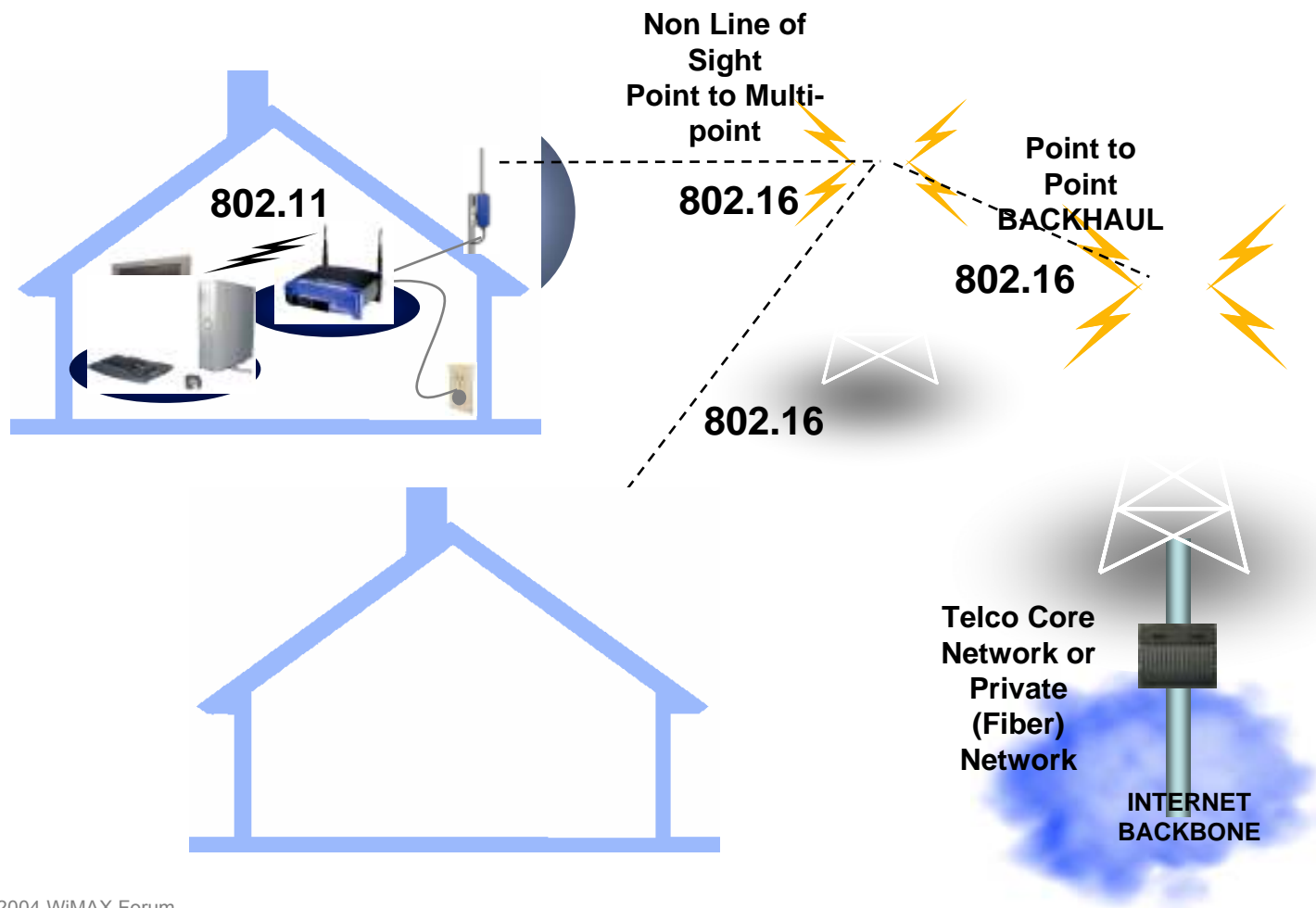
WiMAX Market Opportunity

Network Definitions

- Fixed Network
 - Client devices are stationary and cannot transplant to different cell without operator re-configuration.
- Portable Network:
 - Portable operation is an enhancement over basic fixed indoor/outdoor operation enabling access from multiple network access points but without seamless mobility. (Break before Make)
- Mobile Network:
 - "...support low packet loss handovers and handover latencies to support applications such as near toll-quality VoIP. (Make before Break)

2005 Deployments

Fixed ACCESS With True QoS



2006 - 2007: Portable/Mobile WiMAX Certified Broadband



**802.16 PCI
Express* Form
Factor**

**Laptop Connected
Through 802.16**

802.16

802.16

802.16

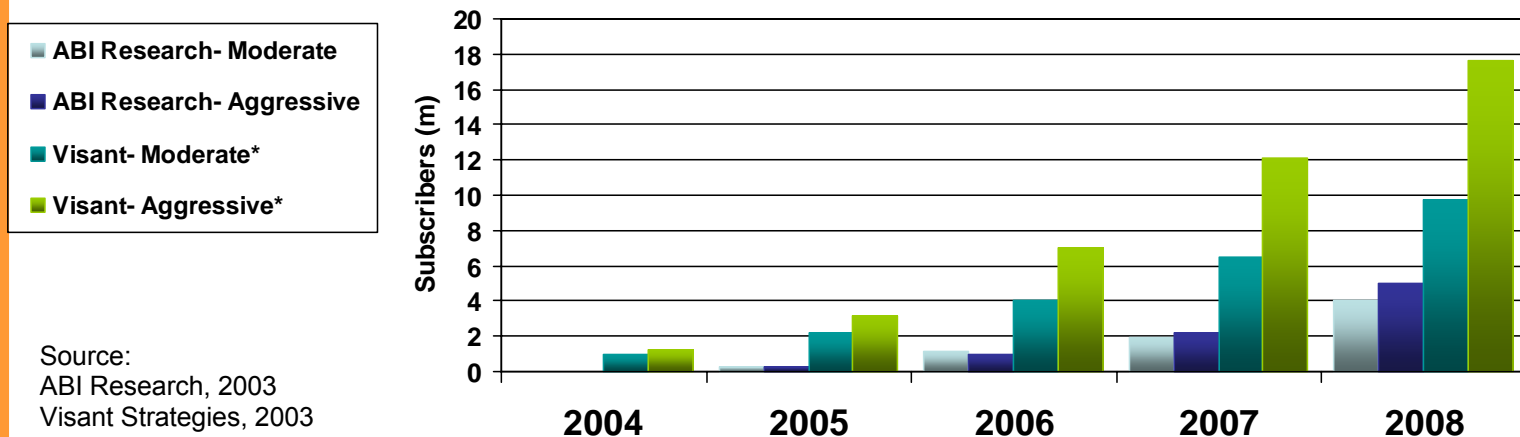
**Line of Sight
BACKHAUL**

**Telco Core
Network or
Private
(Fiber)
Network**

**INTERNET
BACKBONE**

Industry View of WiMAX Potential

802.16 Fixed Indoor/Outdoor Wireless Subscriber Forecast

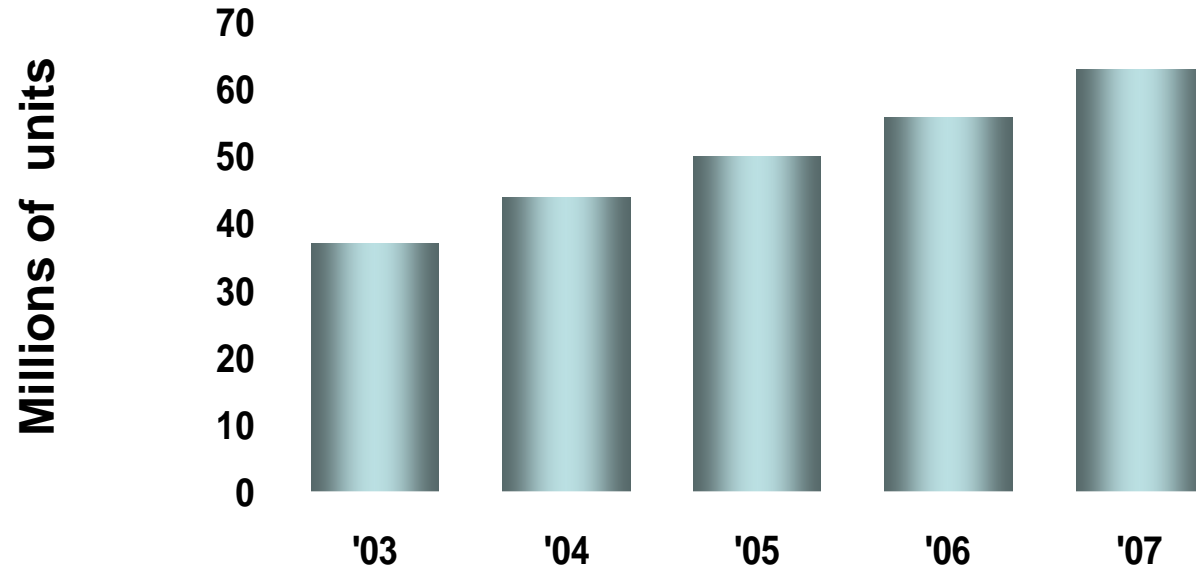


Main Takeaway:

- New Market - variations between analysts forecasts
- Upside for 802.16e (laptop integration) not captured

Mobile Device Potential

Mobile PC Shipments: 2003- 2007



- Sizable opportunity on mobile PC for WiMAX-Certified products
- Example: a 20% attach rate to mobile in '07 doubles the most aggressive analyst forecast for 802.16 clients in that time period

Source: IDC 10/03

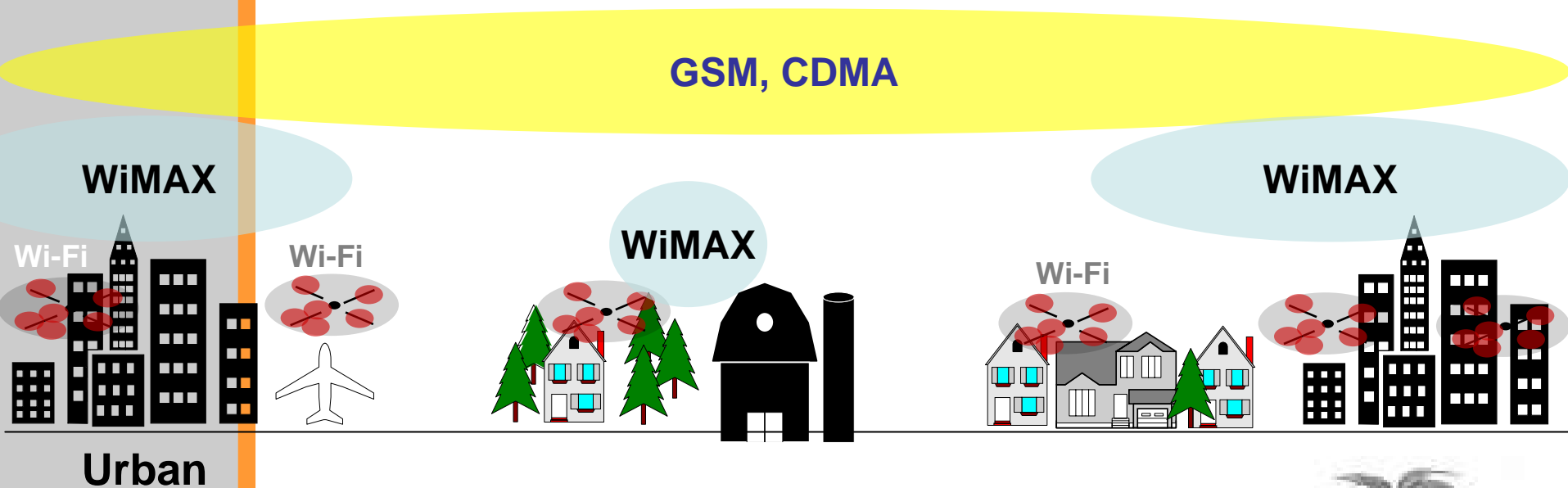
WiMAX and Wi-Fi in the Laptop



Laptop Add-In Card Target Features:

- PCI Express* Form Factor w/ Simplified Network Connection software
- Integrated Lid Antenna

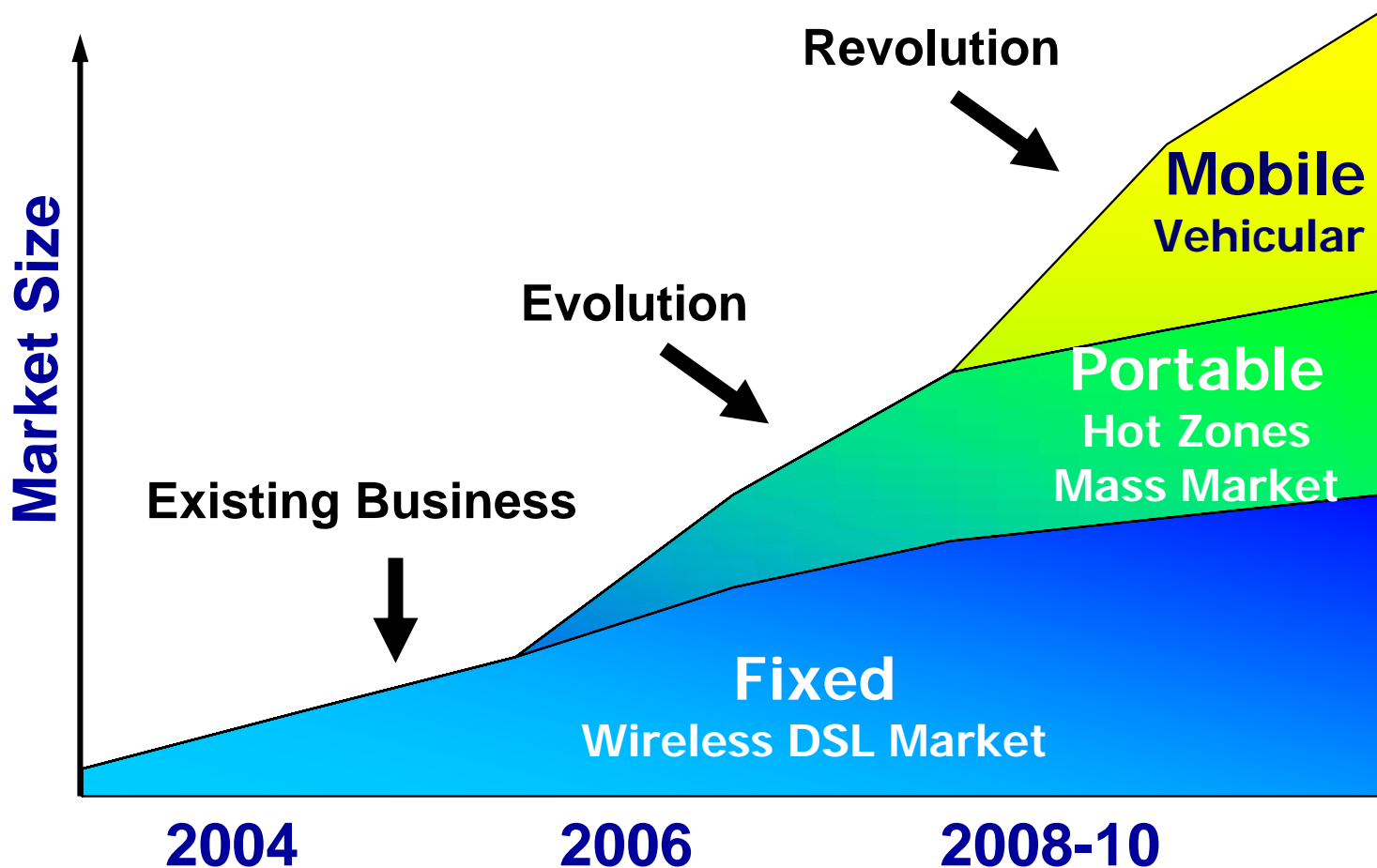
Estimated 2007 – 2008 Mobile Wireless Data Access Networks



Always Best Connected



Broadband Wireless Market Road Map



The WiMAX Roadmap

2004

Going Forward

Fixed Outdoor

Solution Characteristics

- Fixed location
- Installed outside of subscriber's house
- Requires truck roll

Applications

- E1/T1 Level Service for Enterprises
- Backhaul for Hotspots
- Fractional E1/T1 for SM
- Limited residential broadband access (early adopters, rural, developing countries)



Fixed Indoor

Solution Characteristics

- Consumer – self install, auto provisioning
- Portable – can 'move' CPE to another location in service area

Applications

- "Last Mile" Broadband access for consumers
- Portable broadband access



Mobility

Solution Characteristics

- CPE Native in Mobile PC
- User can roam within the service area at varying speeds

Applications

- "Mobile" Broadband access for consumers
- Always Best Connected (SNC)



WiMAX Operators Demands

WiMAX Service Provider Types

1

**Incumbent Fixed Operators
(ILEC)**

**Dominant national operator
with access & backbone
infrastructure**

2

**Competitive Local Loop
Operators (or CLEC)**

**ILEC expanding into new
region or start-up operator**

3

Wireless ISPs (WISPs)

Regional Internet Provider

4

Mobile Operators

**Dense mobile network
operator**

5

Enterprise / Public Safety

Vertical applications

Operators Are Looking For:

- Maximize spectrum utilization
 - Spectrum is limited and may be costly
- Minimize number of base stations to cover targeted geographic area
 - Maximize range, minimize deployment cost
- Meet or exceed customer requirements and expectations for data rate, etc.
 - Meet a predetermined data density
- QoS is mandatory to enable differentiation in an all IP environment
- Competitive added value services

WiMAX Market Vision: *Broadband Everywhere*

2



FRACTIONAL T1 for
SMALL BUSINESS



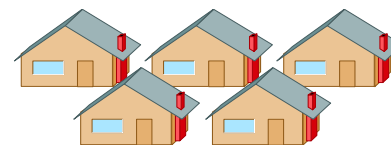
BACKHAUL for
HOTSPOTS

3



Mobile
Backhaul

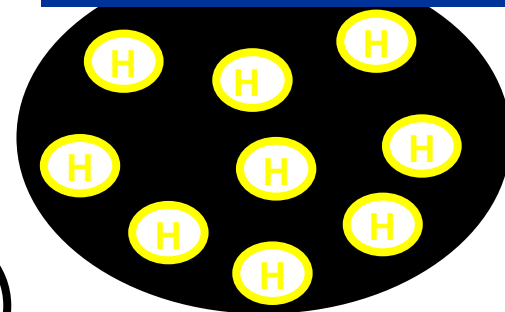
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RESIDENTIAL & SoHo DSL
LEVEL SERVICE

4

WMAN Nomadic Coverage -->
handoff from HOT SPOTS



= wide area coverage
outside of Hot Spots



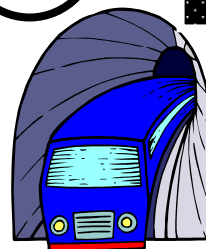
T1+ LEVEL SERVICE
ENTERPRISE



INTERNET
BACKBONE



5



Mobility

WiMAX Forum Regulatory Vision

RWG Charter

- Harmonize existing and new spectrum – make it “WiMAX friendly”
- Advocate policies to ensure cost-effective equipment
- Create an environment to support global roaming for portable and mobile WiMAX devices
- Support policies to ensure consistent end user experiences

RWG Goals

- Harmonize spectrum for initial Forum certification profiles
 - **2.5-2.7 GHz licensed:** US, Brazil, Mexico, Philippines today
 - GLOBALIZE via IMT-2000 efforts
 - **3.4-3.6 GHz licensed**
 - Ensure nomadic use allowed in Fixed Wireless allocations and support for flexible channelization
 - **5 GHz license exempt**
 - Widen adoption of 5.8 GHz in Europe; drive for 4W EIRP globally in 5.8 GHz; widen global adoption of mid-band
- Influence regulators as they consider new bands for fixed and mobile services
 - e.g., 2.3-2.4 GHz, 3.3-3.4 GHz; 3.6-3.8 GHz; sub 1 GHz
- Build awareness for WiMAX among world & regional bodies and influence recommendations
 - Presence at world & regional body meetings: ITU-R, CEPT, APT WF, CITEL, FCC

Regulatory Vision

- Push for global harmonization of rules to foster economies of scale.
- Support for new bands, especially sub-1GHz.
- Encourage regulation that will enable technical ability to support high QoS products being demanded by the market place (Note: Here is where 802.11 falls short, see next slide.).

Comparing Standards

802.11 vs. 802.16

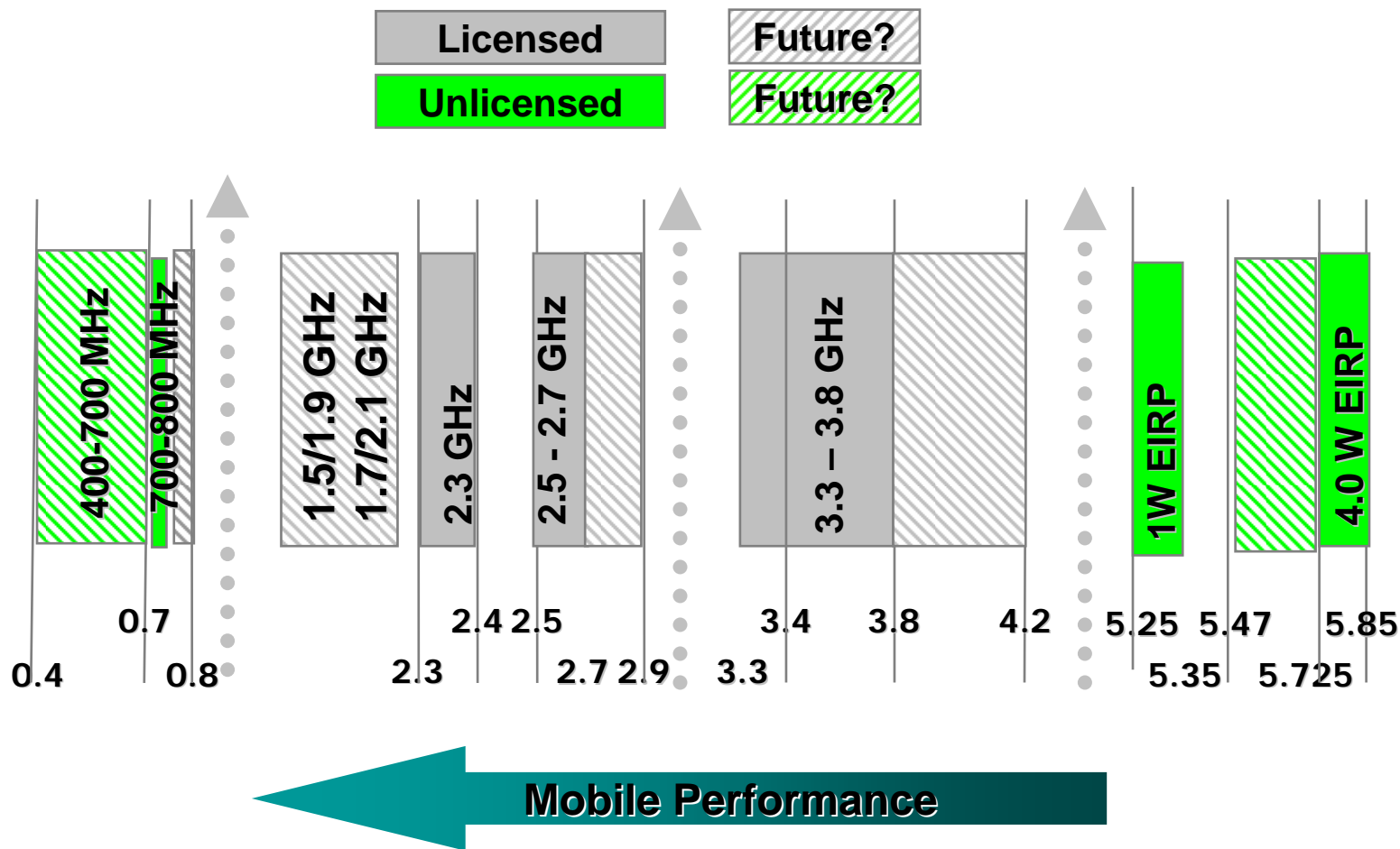
	802.11a	802.11b	802.11g	802.16d
Peak Data Rate	54Mbps	11Mbps	54Mbps	75Mbps
Frequency Band(s)	5GHz	2.4GHz	2.4GHz	2-66GHz
Range	50m	100m	100m	50km
Channel Size(s)	20 MHz	20 MHz	20 MHz	1.5-20MHz
Spectral Efficiency	2.7bps/Hz	0.6bps/Hz	2.7bps/Hz	5bps/Hz
Modulation ¹	OFDM	DSSS	OFDM	OFDM
Quality of Service	No	No	No	Yes
IEEE Certification	1999	1999	2003	2004E

Potential WiMAX Channel Plans

Profile	Band	Channel BW*	Duplex	License
700¹	Upper 700 MHz Band	5 MHz	TDD	Yes
2.3T1¹	WCS Band	5 MHz	TDD	Yes
2.5T1	BRS-EBS Band	5 MHz	TDD	Yes
3.5T1	3.5 GHz Band	7 MHz	TDD	Yes
3.5F1	3.5 GHz Band	3.5 MHz	FDD	Yes
5.8T1	5.8 GHz ISM/UNII	10 MHz	TDD	No

¹ future potential WiMAX bands & channels

< 6 GHz Spectrum for Possible WiMAX Use



*** Pockets of indicated spectrum are available in various countries**

WiMAX View on 3650MHz

“Co-Existence Based”

- Official publicized view is TBD, however WiMAX Forum will file comments requesting the FCC alter the R&O language from “**contention-based**” protocol to “**co-existence based**” protocol.
 - This will accomplish exactly the intent of the rule without overlaying a SPECIFIC technical requirement (e.g. contention based) that forces the industry to institutionalize a specific technical component, namely an old protocol. (This runs contrary to recent trends of FCC rules that try to encourage innovation and resists naming specific technical mechanisms.)
 - The term “co-existence” is broader in that it allows for innovation of new and better protocols that can better adapt to interference, provide for more efficient use, foster better band sharing, enable better operator scaling, and support the levels of QoS being demanded by end customers.

Note on System Profile Creation

- While it is true that Intel's position on 3650MHz is that it should be licensed and they claim they will not support and unlicensed 3650MHz, the WiMAX Forum charter allows for creation of a system profile for a new band if at least three principal members.
- Already, at least 4 principal members have the intention of using 3650-3700MHz, so creation of a profile can be supported by the WiMAX Forum.

Summary

Summary

- WiMAX technology has broad support of key members across the entire telecom landscape.
- The market potential for WiMAX is real.
- The industry is trending toward and all IP, converged future. Such requires strong QoS to differentiate the distinct applications.
- Contention-based protocols inherently do not enable good QoS.
- Changing the language to “co-existence” preserves the FCC intentions for 3650MHz while supporting innovation and much better levels of service to the end customer.



Alvarion Position on 3650 MHz Band



Meeting with FCC April 4, 2005
By Duane Buddrius, Director Product
Engineering and Product Management

- Alvarion at a Glance
- Global Wireless Broadband Market
- The Next Generation High-Speed Broadband Access
- Alvarion Brings BreezeMAX
- Issues with the 3650MHz Band Rules

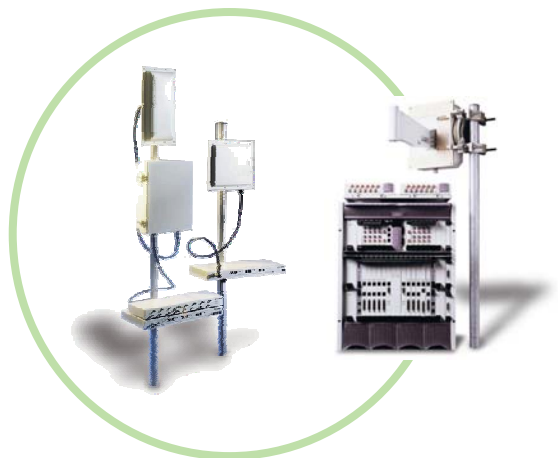
1

Alvarion at a Glance

- The worldwide leader in wireless broadband with over 2,000,000 units installed
- U.S. leader among telcos, utilities, rural cellular carriers, municipalities, & mobile public safety
- Installations in over 130 countries
- Over 5,000 U.S. towns and cities covered
- Strong OEM channels with Siemens, Alcatel, Nera & Datang
- Working with more than 200 partners
- 2004 revenues \$201.5M – 36.5% growth over 2003
- About 700 employees (over 250 R&D engineers)
- Financially strong, profitable with \$133M cash reserves, NASDAQ: ALVR
- Pioneering leader in standards development since first 802.11 standard
- Leader in WiMAX Forum™
- Acquired Interwave for \$56M cash; Specialized GSM and CDMA base stations



Alvarion Wireless Broadband Solutions



WALKair



BreezeMAX



BreezeACCESS



BreezeNET



**Breeze2000 and UltraWave
GSM/CDMA**



MGW / eMGW

All Major Global Frequencies Supported

26/28 GHz

10.5 GHz

5 GHz

3.5 GHz

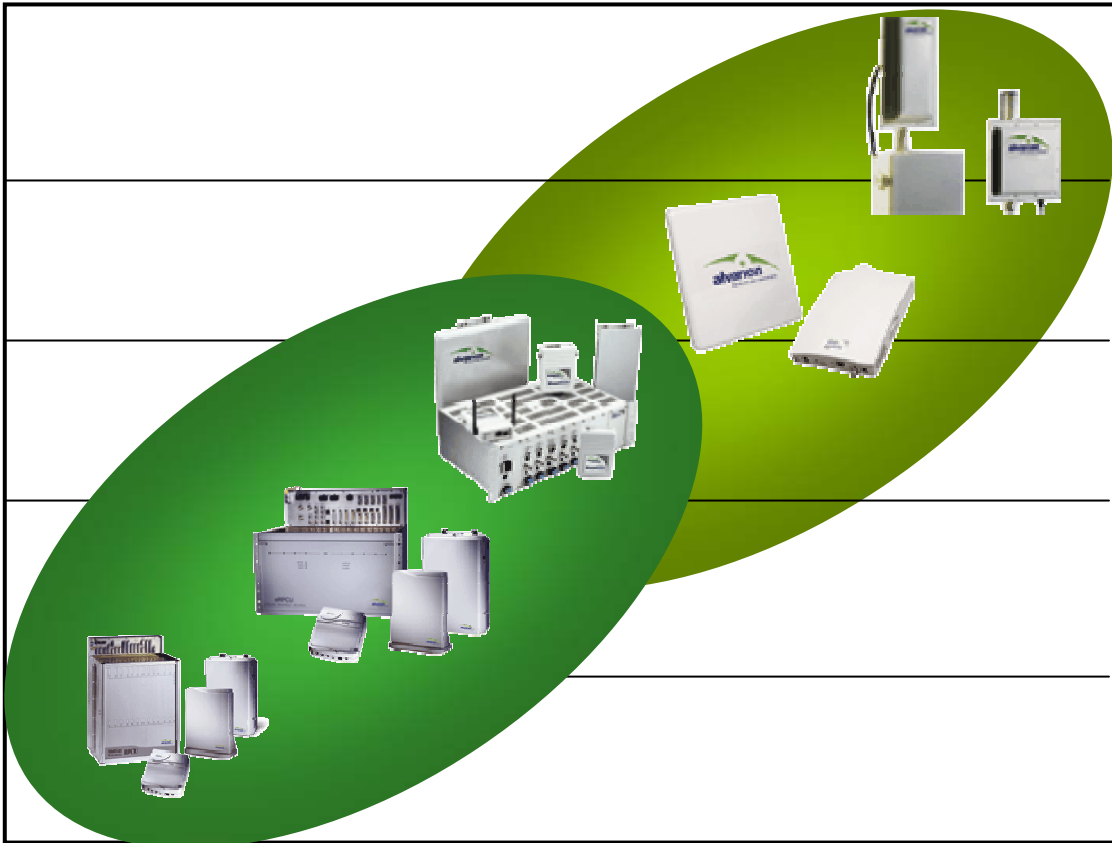
2.5 GHz

2.4 GHz

1.9 GHz

900 MHz

800 MHz



Residential

SOHO

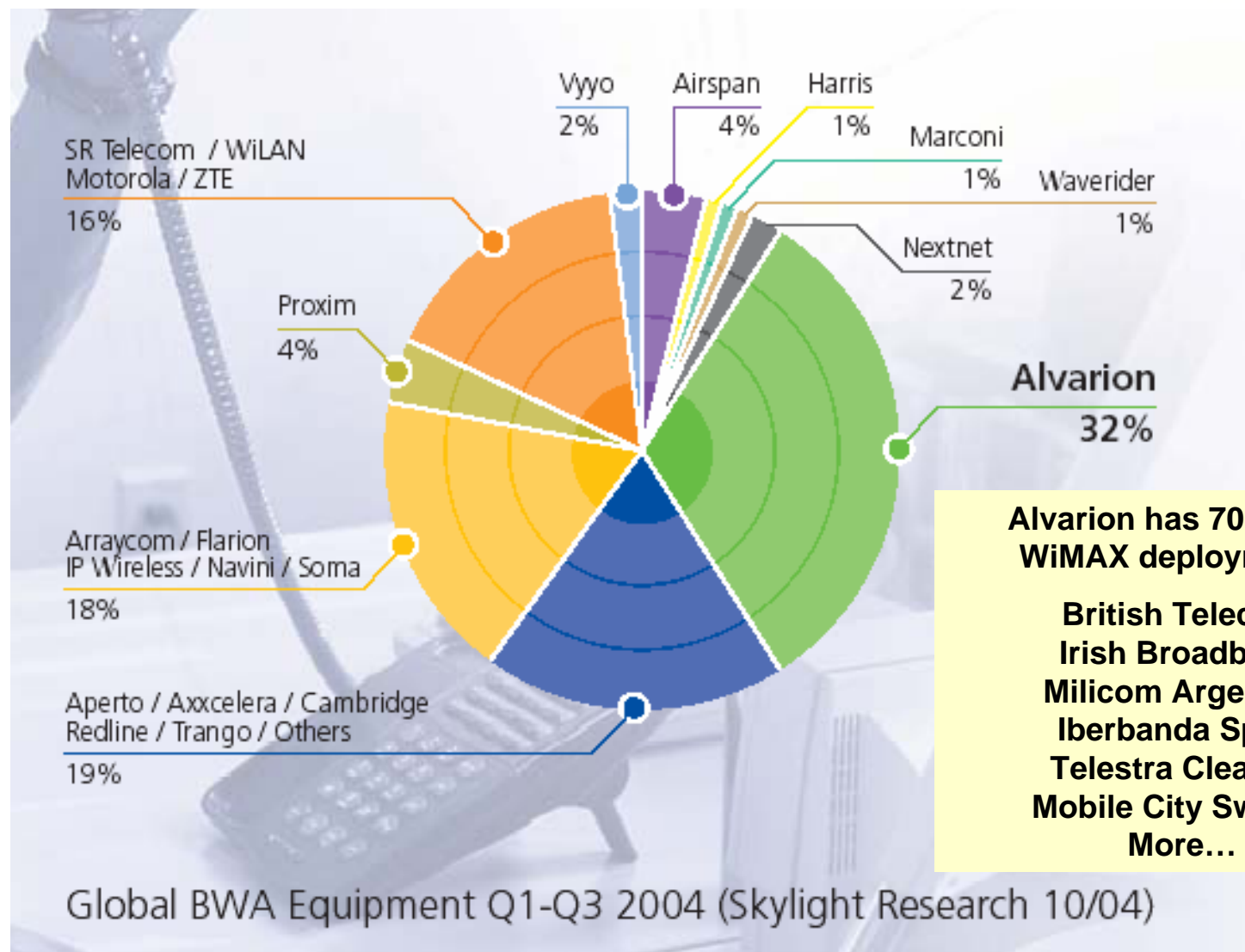
MTU

SME

MBU

LE





Alvarion Global Presence



- 17 offices worldwide
- More than 130 countries
- Over 2,000 customers
- More than 200 partners

OEM Partners



Regional Channels



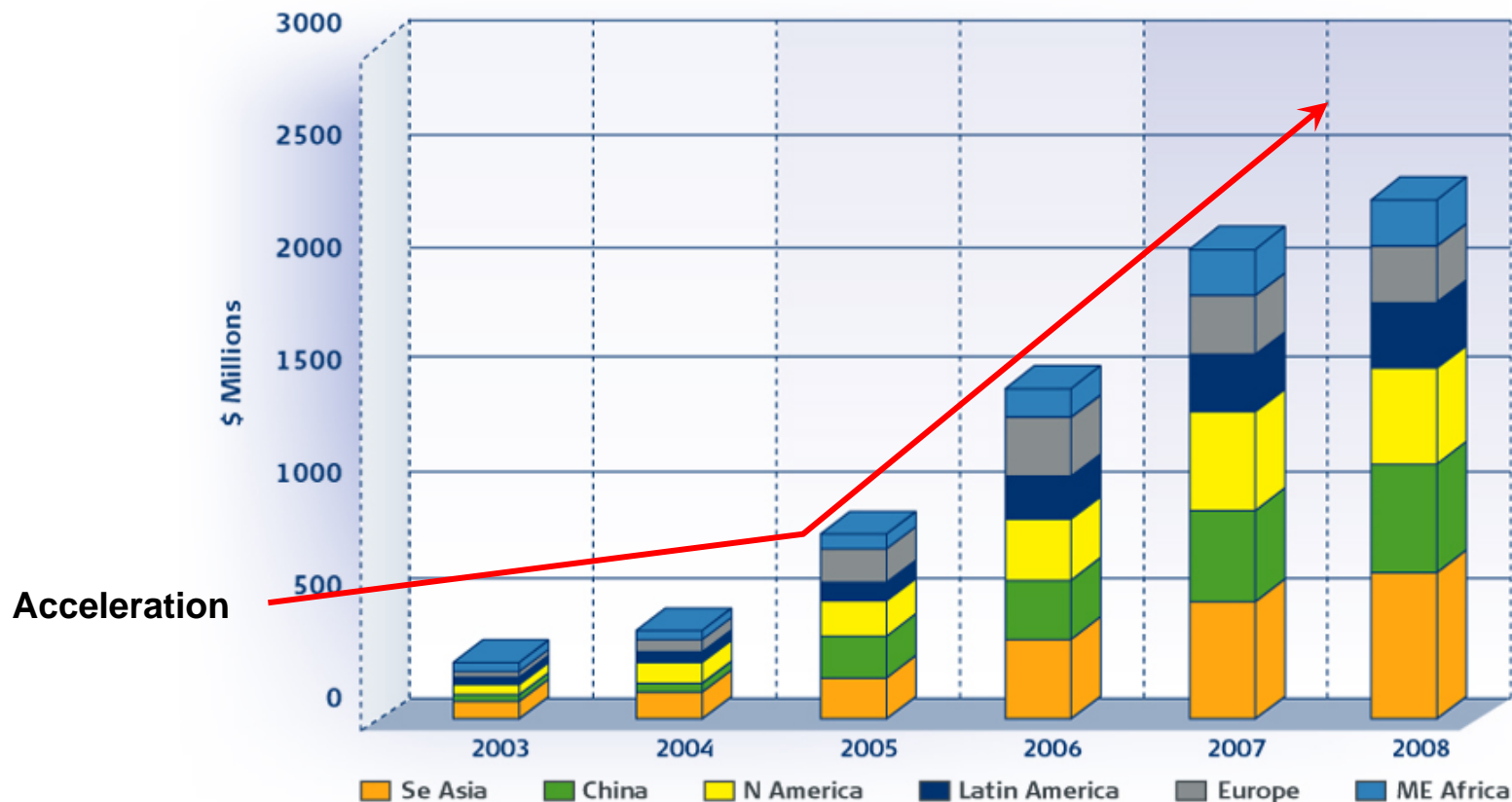
- WiMAX
 - Vice President
- ETSI BRAN HiperMAN
 - Chair
- Wireless Communications Assoc. (WCA)
 - Board member
 - Executive Committee, License Exempt Alliance
 - Foster WW growth of wireless broadband systems over license exempt spectrum
 - Chair, BWA Task Force for Mobile Operators
- IEEE 802.16d
 - Participating in the definition of profiles for 802.16a
- IEEE 802.16e
 - Participating in the drafting of mobile PHY / MAC features
- IEEE 802.16h License Exempt Task Group & Coexistence Protocols
 - Chair position



2

The Global Wireless Broadband Market

Worldwide Broadband Wireless Equipment Revenue < 10GHz



\$305M in 2003 → \$2.9B in 2008 = 5 yr CAGR of 52.2%

Source: Sky Light Research 2004

Standardized Technology

WiMAX- 802.16



2nd Generation Technology

economical, high quality
wire line alternative

Acceleration
Stage

Regulation Evolution

Increased allocation of
Licensed and Unlicensed
bands

Carrier Demand

to serve 'White Zones'
& 'DSL Refugees'



3

The Next Generation High-Speed Broadband Access

Operator Requirements

WiMAX addresses by ...

True Broadband Speeds

- ...delivering > 1 Mbps per user (DSL business model)

NLOS Operations

- ...providing strong multipath protection (indoor self install)

High Link Budget

- ...enabling >150-160 dB of link budget

High Number of Simultaneous Sessions

- ...offering 100's simultaneous sessions per channel

Courtesy of the WiMAX Forum, March 2004



High Spectral Efficiency

- ...giving >3.8 bps/Hz in 64QAM mode w/ cell radius >50 km in QPSK

Large, Globally Unified Channel Bandwidth

- ...making 1.5 and 20 MHz channel plans match with worldwide regulatory regimes.

Low Latency

- ...meeting operator requirements for voice, video and data applications

IP Quality of Service

- ...granting full Class, Service, Protocol and Application based differentiation can be provided for Layer 3 – Layer 7 protocols

Courtesy of the WiMAX Forum, March 2004



- Component makers
 - Standard based on IEEE 802.16-2004
 - Global Harmonization – common spectrum allocations and operational rules
 - Creates a *volume* opportunity for silicon suppliers
- Equipment makers
 - No longer need to develop every piece of the end-to-end solution
 - Can innovate more rapidly
- Operators
 - Multiple equipment suppliers and lower costs = lower investment risk
 - Generate revenue by filling broadband access gaps
 - Quickly provision T1+ level and “on demand” high margin broadband services
- Consumers
 - More choices for getting broadband access



4

Alvarion Brings BreezeMAX

Alvarion's BreezeMAX



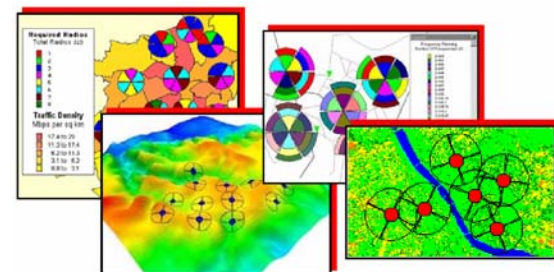
- The industry's first WiMAX-ready system built from the ground up to support WiMAX Forum™ profiles.
- Alvarion's 4th generation OFDM solution incorporating our 12 years of market leading technical expertise and deployment experience.

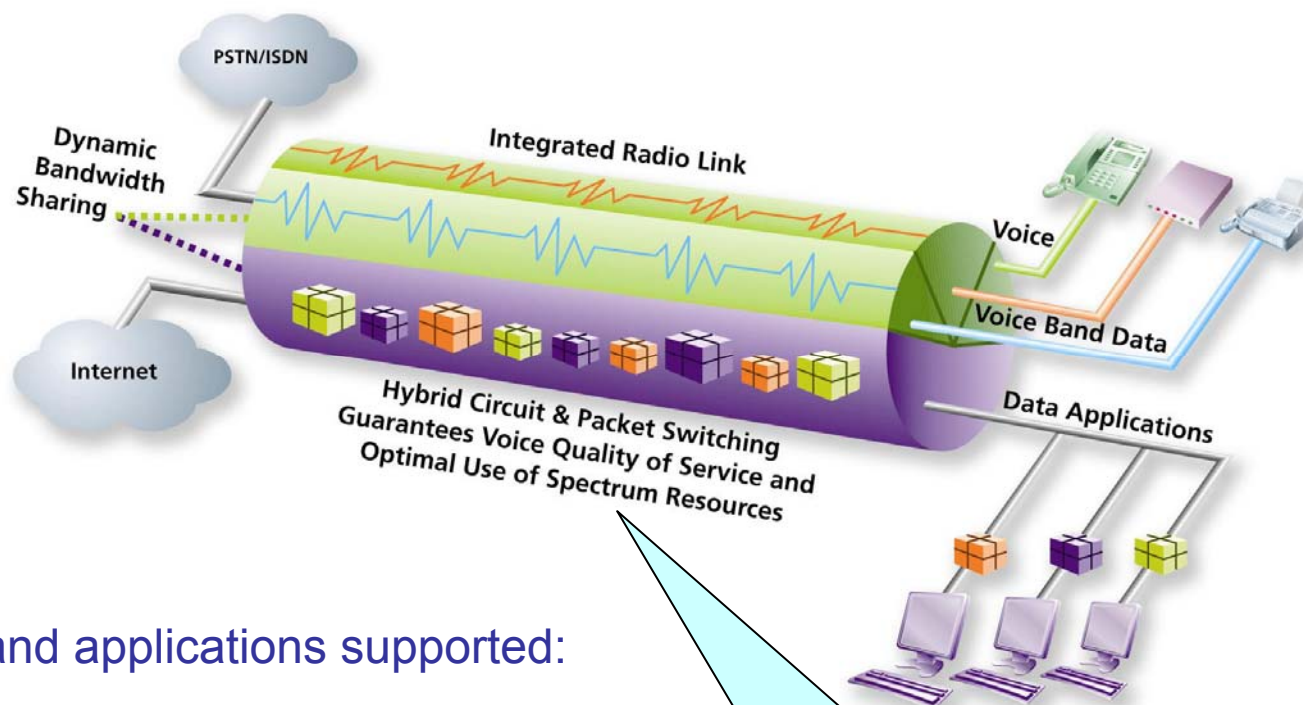


BreezeMAX – Highlights



- Multiple Backbone types
 - 100BaseT/GigE and ATM data network interfaces
 - GR-303 TDM interfaces to Local Exchange (16 x T1)
- Multiple RF unit configurations
 - Multiple sectors per base station
 - Multiple channels per outdoor unit
 - Multiple antennas per sector (smart antenna technology)
- Comprehensive family of CPE
 - Data only
 - Data + 2 Voice Ports
 - Enterprise CPE bridge with integrated 802.11g Wi-Fi
- Resource management for packet and circuit switching
 - PSTN call processing
 - Voice Processing: echo canceling, fax/modem detection
 - Bandwidth and SLA management
- Interfacing to the NMS: monitoring, alarm, configuration





- Services and applications supported:
- Data services – DSL and Cable equivalent
- Voice services – true TDM or VoIP
- Leased line services – E1/T1
- Layer 3 IP VPN services

802.16 brings true QoS to TDM and Voice Services. This is designed into the core of the protocol.

Product Availability

2004 →

2006 →

2007 →

Fixed BWA

- License and Licensed-exempt Spectrum:
2GHz – 6GHz
- Fixed outdoor Subscribers
- National Operators, Competitive Carriers and ISPs.
- Target subscribers:
 - Residential users
 - Enterprises
- Voice, Data & leased line services



Portable BWA

- Licensed and Licensed exempt spectrum
- Fixed , Self-Installed CPEs, Portable CPEs
- Fixed Network Operators, Mobile Network Operators, Competitive Carriers & ISPs
- Target subscribers:
 - Residential users
 - Enterprises
 - Business users
- Voice & Data services

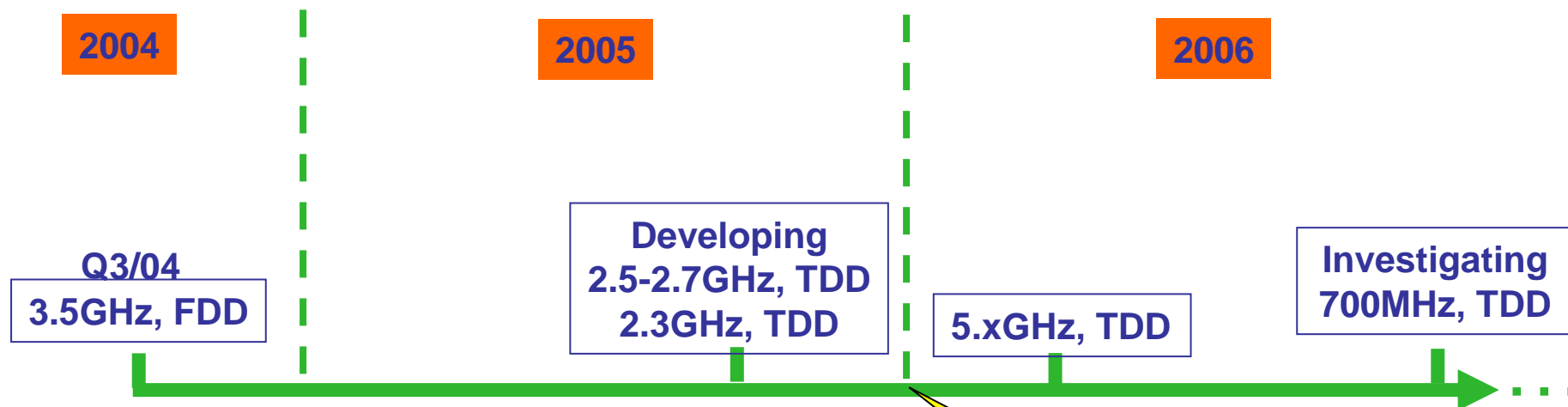


Mobile BWA

- Licensed spectrum
- Mobile Subscribers
 - PCMCIA cards
 - Embedded WiMAX chip (Notebooks, PDAs)
- Fixed Network Operators, Mobile Network Operators & Competitive Carriers
- Target subscribers:
 - Residential users
 - Business users
- Voice & Data Services

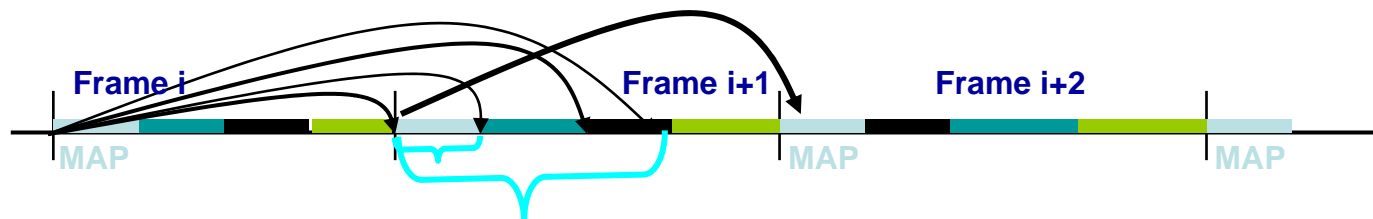


BreezeMAX Frequencies Road Map

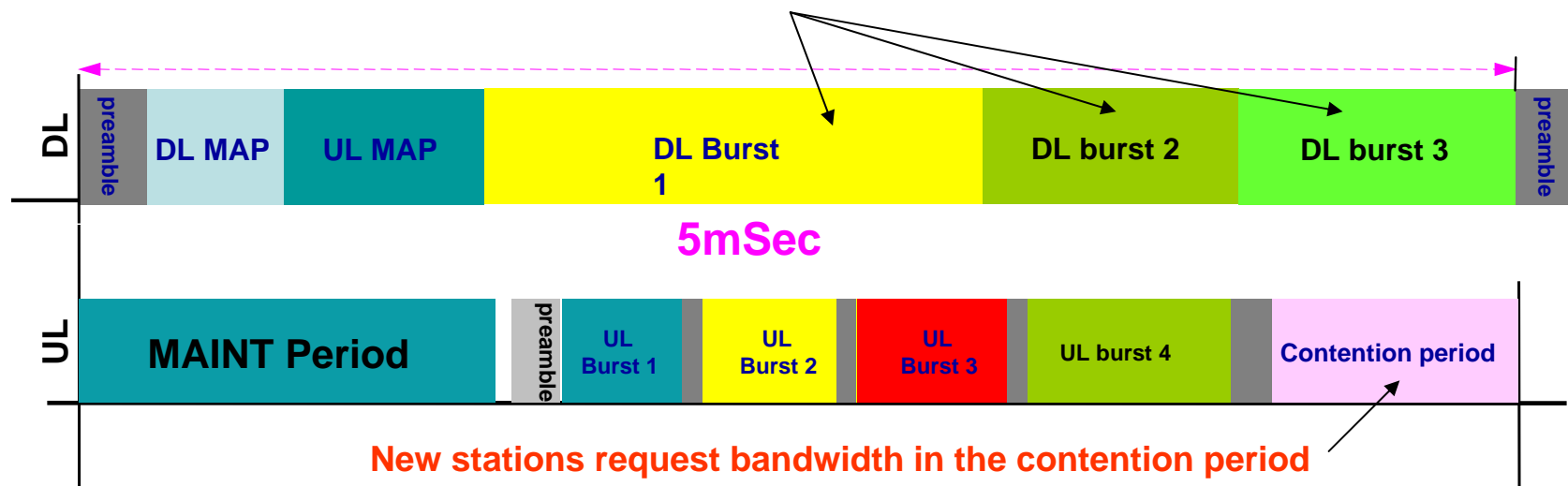


How does WiMAX control traffic and QoS?

- **Connection based traffic classifications;**
Real Time Variable Rate, Non Real Time Variable Rate, Best Effort
- The 802.16 protocol is TDM. The map header describes the next frame.
- The MAP which is transmitted in frame{i+1} is planned during frame{i} and refers to the bursts that will be transmitted on frame{i+2}.



Each burst is defined by PHY parameters such as modulation, coding and each burst starts and ends on an OFDM Slot boundary



- You can see that Quality of Service depends on coordination and timing.
- If the MAP header is destroyed, then no station knows what to do.
- If the frames can not be transmitted when they are scheduled, then the “real time services” are no longer real time.
- Without QoS, service providers can not offer competing services to those offered by DSL and Cable.

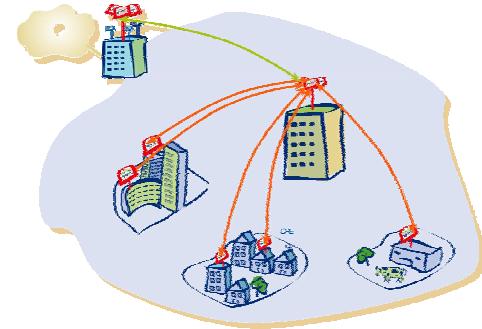
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Issues with the 3650MHz Band Rules

Issues with the 3650MHz band rules



1. Requirement for “contention-based” protocol



- What does the FCC specifically mean “contention-based”?
- WiMAX – 802.16 is not a contention based protocol.
- What about coexistence rather than contention?



WiMAX is the industry direction, however:

- With a “contention-based” requirement we lose the key benefits of WiMAX which are service provider requirements.
- The FCC rules are not in harmony with 802.16 or WiMAX.
- Further protocol development will be required with the unfortunate effect of delaying product availability.



- FCC already works to harmonize with global spectrum allocations
- FCC has made huge strides in making spectrum available on shared basis
- Harmonize with Industry standards
 - Smarter methods of sharing the bands without losses in efficiency
- Support 802.16 efforts on coexistence



Thank you
duane.buddrius@alvarion.com





IEEE P802.16h and 3.65GHz band



Mariana Goldhamer
IEEE 802.16 LE TG (802.16h) Chair
Director Strategic Technologies - Alvarion

- **Meeting Objectives**

- Present the limitations of “contention based” protocols
- Present a non-802.11 Wi-Fi and 802.16

- **Inter-system coexistence based on CCA and contentions**

- **P802.16h possible solutions in the context of 3.65GHz R&O**

- **Conclusion and next steps**

- **Back-up slides**

● Scope

- To specify improved mechanisms, as policies and MAC enhancements, to enable coexistence among license-exempt systems based on IEEE Standard 802.16 and to facilitate the coexistence of such systems with primary users

● Applicability

- Un-coordinated operation in all bands in which 802.16-2004 is applicable

● Market problem to resolve

- **No service guarantee in LE bands**
 - No minimum data rate and QoS guarantee
 - Bad spectral efficiency
 - Low cell size
- Operator lack of confidence in deployment business model
- More info: <http://ieee.802.org/16/le>

• High spectral efficiency

- 802.16: MAP field (few bytes) for every scheduled transmission
- 802.11: 2 supplementary messages for every transmission
 - RTS (Request to Send) and CTS (Clear to Send)

• QoS

- 802.16: scheduled transmission, guarantees QoS
- 802.11: **contention-based** protocol, no QoS guarantee; Clear Channel Assessment (CCA) is done at transmitter location and the interference is experienced at RECEIVER location; 500m distance may introduce between them >100dB isolation

• Capacity at high offered traffic load

- 802.16: insignificant degradation
- 802.11: totally collapses at high requested traffic due to **contentions**: the retransmission overhead may be higher than the traffic itself!

• Cell size

- 802.16: up-link sub-channelization/OFDMA gives up to 15dB more
 - 2...4 times higher as compared with 802.11, NO contentions
- 802.11: limited by time constants and **contentions**
 - Needs very high $C/(N+I)$ even for low modulation orders: Clear Channel Assessment is done at transmitter location and the interference is experienced at RECEIVER location
 - In large BWA networks there are long distances and all the process may not work well

- **CSMA/CA and “Clear Channel Assessment” before transmissions**
 - **Incompatible with the scheduled transmissions concept → NOT providing QoS**
 - **Destroying the high-spectral efficiency concept**
 - A scheduled interval for transmission shall include time for other transmissions, even if they do not take place
 - **Incompatible with directional antennas**
 - Antenna isolation may cause CPE to be hidden from each other
 - **Creating interference to neighbor CPE**
 - A CPE may not “see” a foreign Base Station transmission to a neighboring CPE belonging to that network and thus may transmit at times when the neighbor CPE is in Receive state
 - **Does not prevents the interference at RECEIVER location**

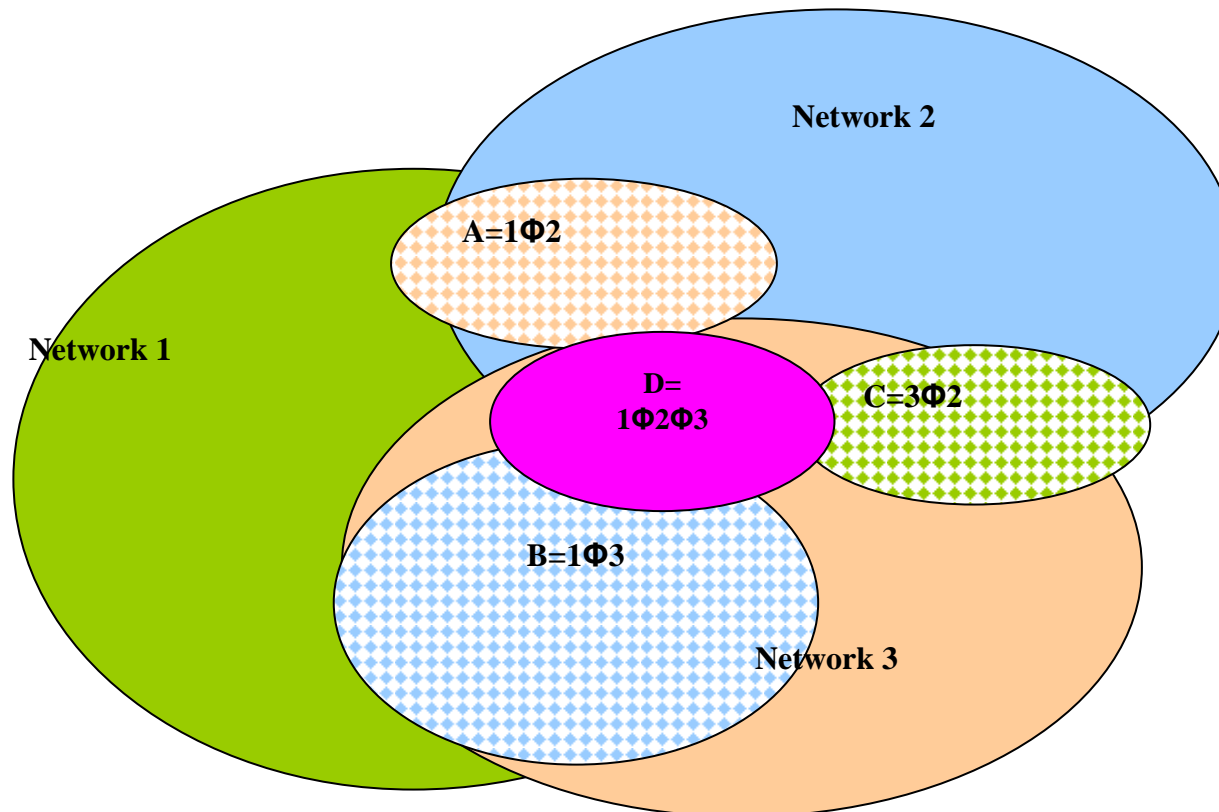
● Separation in frequency

- May not be possible in all the locations
 - Adjacent and 2nd adjacent channel interference
 - Radio front-end saturation
 - Lack of Tx/Rx synchronization

● Separation in time

- Provides for guaranteed minimum traffic
- Allows mixing of different technologies

Separation in time - example

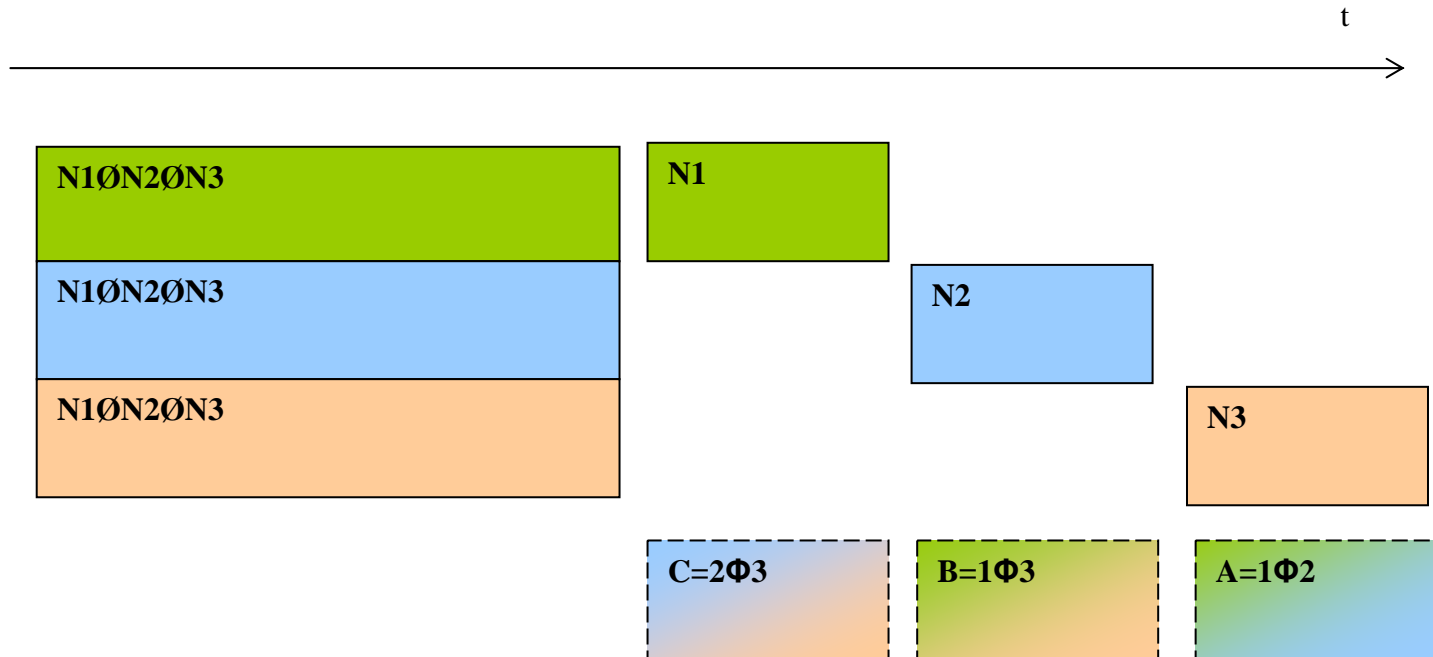


Legend:

Network i

Sub-network j, k not interfering with Network i

...And possible traffic scheduling

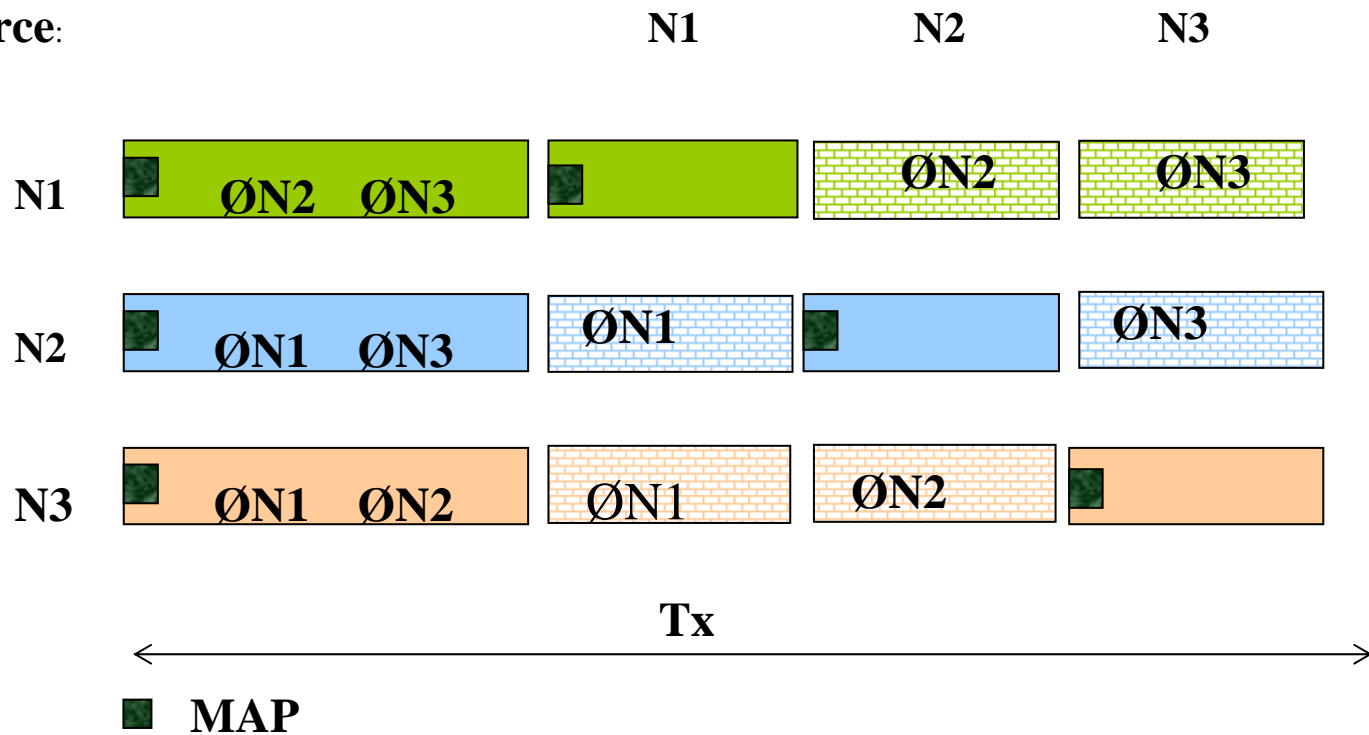


Conclusion:

Every system may use 100% of spectrum, with interference avoidance!!!

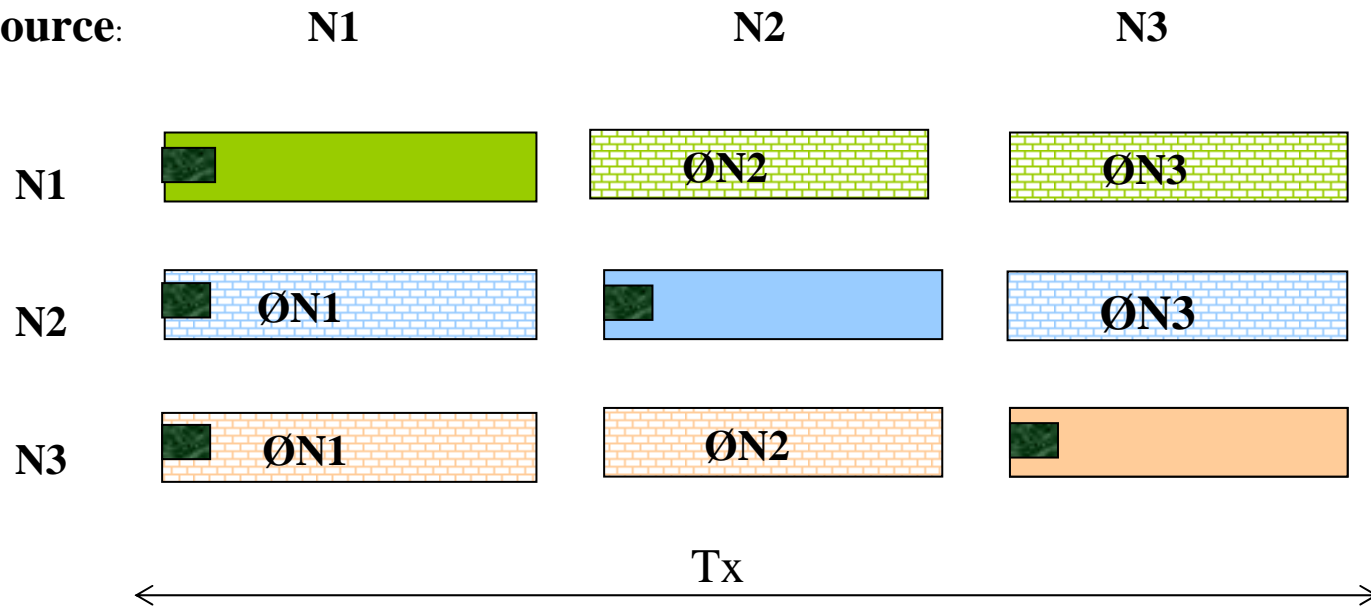
Scheduling in context of 802.16 – MAC frame

Owner of the
Radio Resource:



Scheduling in context of 802.16 – MAC frame, alternative approach

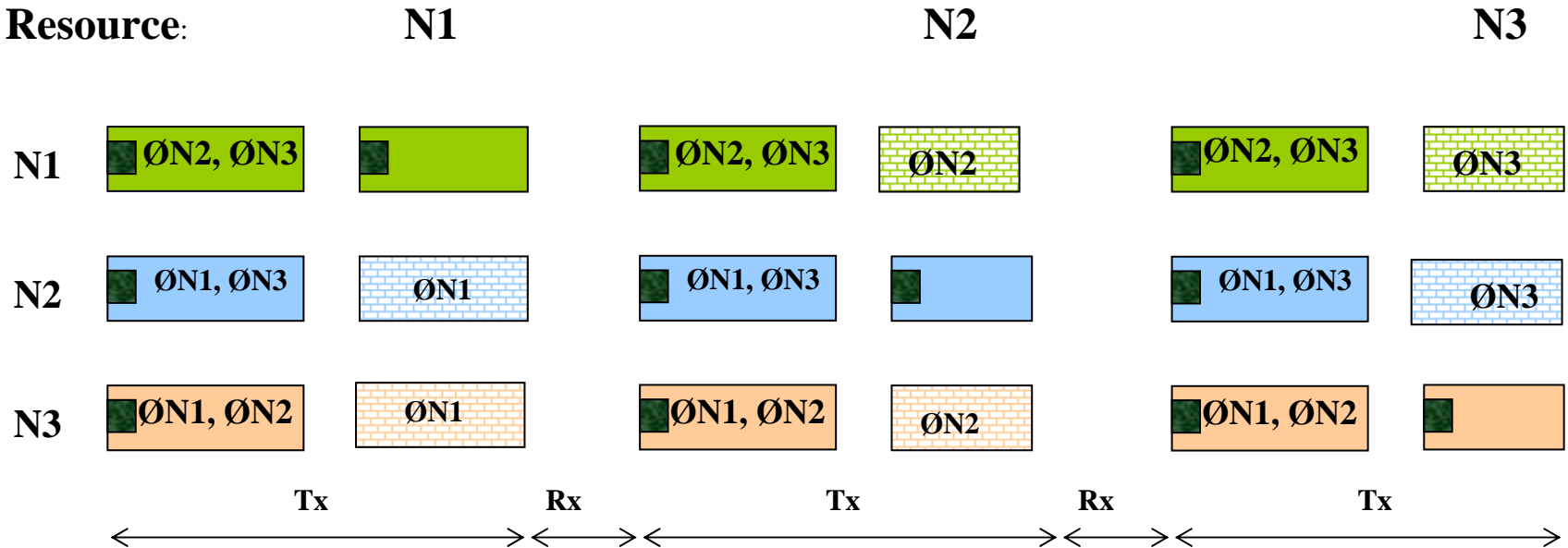
**Owner of the
Radio Resource:**



Scheduling in context of 802.16 – repetitive MAC Frame



Owner of the
Radio Resource:



Advantage: Easier management of time resource

- **Requirement for a Coexistence protocol**
 - **802.16h fits the definition**
 - A protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate
 - **The term “contention-based” protocol is too suggestive of a particular solution and is NOT technology neutral:**
 - FCC should change the name to “coexistence protocol”
- **Introduces a “Base-Station” data base**
 - Neighborhood Base Stations may be identified
 - Adding an IP identifier (as BS007@winet.com) will enable dynamic radio resource sharing, using BS to BS communication.
 - Service providers are identified
- **Includes obligation of the licensees to collaborate and avoid harmful interference**
 - Using the same coexistence protocol may satisfy this obligation

Protocol proposal in the context of Part Z – 3.65 GHz



- **Starting from the FCC Operators' Base Stations data base**
 - Establish the number of operators in a given area
 - Establish the MAC frame division in time
- **Establish interferer identification**
 - Create a multi-frame, every transmitter having a short slot for its sole transmission
 - Identify the transmitter based on frame number and slot number and/or GPS time
- **Establish messages for dynamic radio resource allocation**
 - Affect the duration of reserved slots, based on agreement between the networks involved
 - If one network experiences low interference, may let other networks to increase the time in which they work in parallel
 - If one network experiences interference, may ask other networks
 - Specific transmitters to cease the operation in parallel
 - Increase its reservation time and define the new time

- **Establish rules of behavior based on:**
 - actual traffic load
 - actual interference levels and duration
- To be a basis for “type approval”
 - Avoid stealing radio resource

● **Technology agnostic**

- The communication between base stations takes place at IP level
 - The IP identifier should be known from the FCC data base
- Multi-frame definition will be based on a general time-base (seconds)
- Every network will have its allocation for:
 - High transmitting powers
 - Interference-free reception
- May accommodate
 - WiMAX systems
 - Bursty systems
 - Mesh systems

● **High spectral efficiency and QoS**

- Scheduled approach
- Suitable for WiMAX applications

● **Large cell size**

- Minimization of interference

● **Enforces fairness and collaboration**

- **FCC feedback needed**
- **May be a basis for “type approval”, if supported by WiMAX Forum**
 - Large enough industry consensus
- **However:**
 - The coexistence problem remains, if different and incompatible protocols will be accepted by FCC
 - Operator lack of confidence in using the band
 - Building the industry consensus on one single protocol may require many years
 - Delay the market
 - Will 802.16h proposals become “de facto” protocol ?

- **Contention-based protocols (IEEE 802.11)**

- Destroy the QoS
- Decrease significantly the spectral efficiency
- Not optimal for WISP market

- **ETSI BRAN HiperMAN**

- Highly harmonized with IEEE 802.16
- On-going strong cooperation

- **ETSI BRAN System Reference Document for Fixed-Nomadic BWA**

- Mention 802.16h work on inter-system coexistence

- **FCC ruling is a revolutionary step for better spectrum usage**
 - Enforces coexistence based on Base Station data base and protocols
 - Provides premises for opening more spectrum in shared bands
 - Significantly increases the market
 - High potential to be followed world-wide
 - Alvarion is committed to contribute

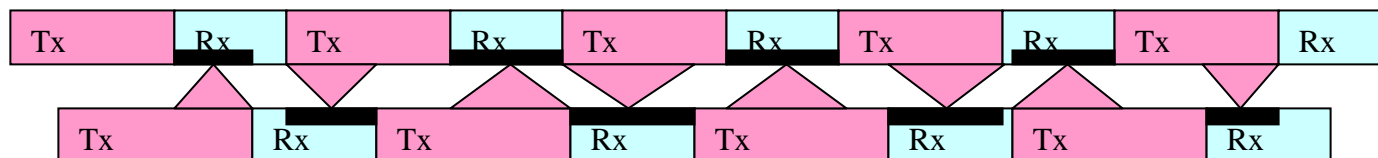
- **FCC participation in IEEE 802.16h meetings**
 - Will give timely feedback to 802.16h standard development
 - Ofcom-UK and Industry Canada already joined last meeting

Thank you !

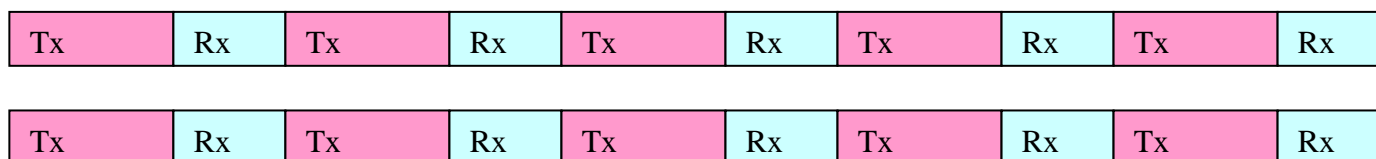
marianna.goldhammer@alvarion.com

- **BS to foreign BS and ST to foreign ST interference problem**

- Generated by TDD environment

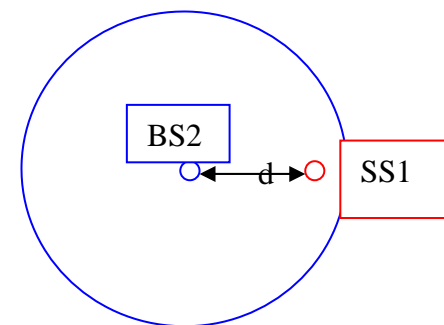


- Can be mitigated by Tx/Rx synchronization



- **BS to foreign ST and ST to foreign BS**

- Exist in both FDD and TDD environments
- Can conduct to Radio saturation
- Affect the receive sensitivity level
 - Coordination or Guard band are necessary



BS to ST or ST to BS interference: 2.4GHz, LOS, FCC high power rules



1st Adjacent Channel

RSL degradation (dB) and interference level at BS1, BS2 at x meters	BS Omni, SS Omni		BS Directional SS Directional		BS Directional, SS Omni	
	Level (dBm)	Delta_RSL	Level (dBm)	Delta_RSL	Level (dBm)	Delta_RSL
50	-28.98	38.02	-21.98	45.02	-28.98	31.02
100	-35.00	32.00	-28.00	39.00	-35.00	25.01
250	-42.96	24.05	-35.96	31.04	-42.96	17.12
500		18.08	-41.98	25.03		11.35
1000		12.26		19.05		6.19
1800		7.70		14.06		2.96
2750		4.90		10.60		
3500		3.60		8.74		
4500				6.92		
6000				5.06		
8000				3.50		

2nd Adjacent Channel

RSL degradation (dB) and interference level at BS1, BS2 at x meters	BS Omni, SS Omni		BS Directional SS Directional		BS Directional, SS Omni	
	Level (dBm)	Delta_RSL	Level (dBm)	Delta_RSL	Level (dBm)	Delta_RSL
50	-28.98	19.07	-21.98	26.03	-28.98	12.28
100	-35.00	13.21	-28.00	20.04	-35.00	6.97
200	-41.02	7.77	-34.02	14.15	-41.02	3.00
450		2.98	-41.07	7.73		
700				4.83		
1000				3.01		

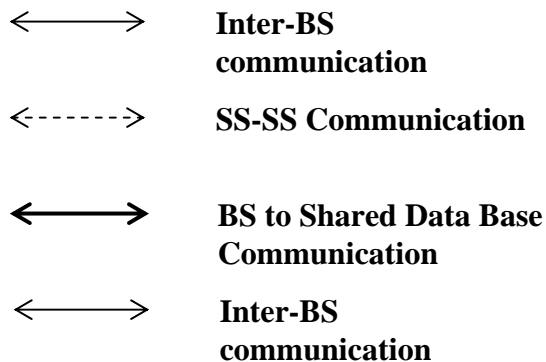
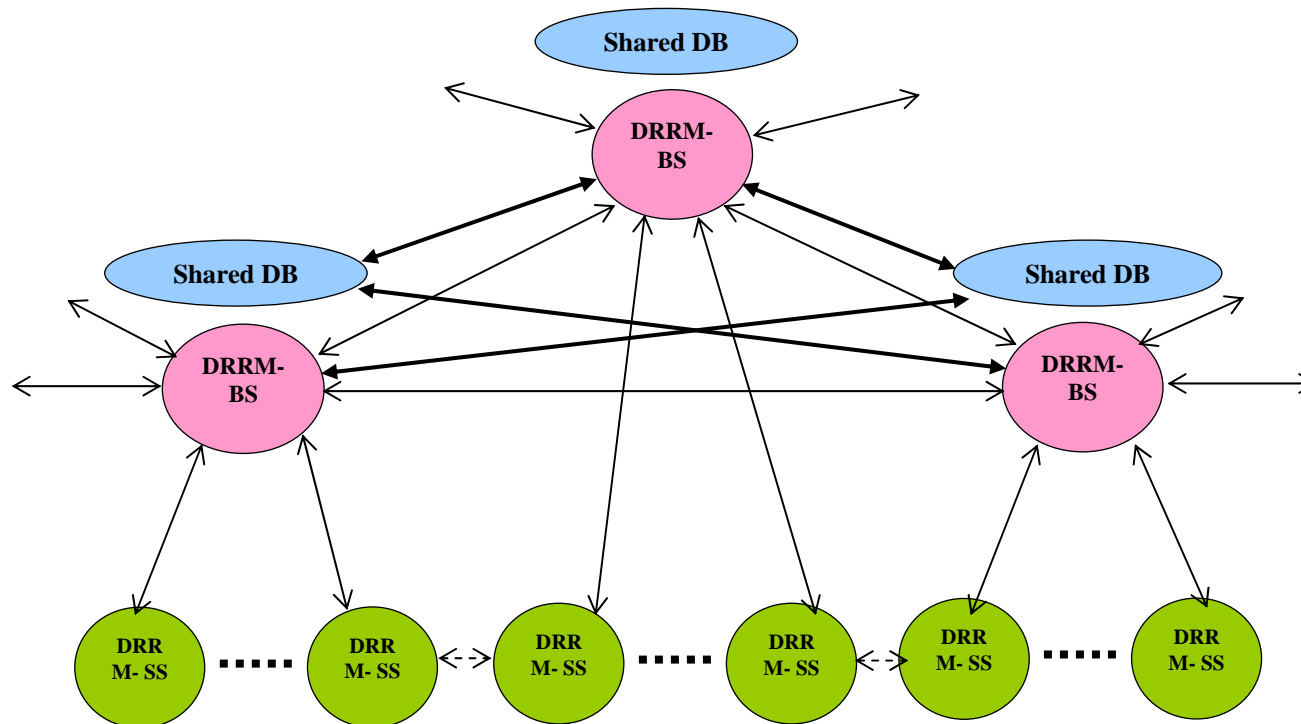
See technical analysis: http://ieee802.org/16/docs/04/C80216-04_14.pdf

- **Interference detection and prevention – general architecture**
- **Identification of interference victims and sources**
 - Identification of the interference situations
 - Identification of spectrum sharers
 - Regulations, messages to disseminate the information, avoidance of false-identification situations, storage of identification information
- **Interference prevention**
 - Adaptive Channel Selection – ACS
 - Dynamic Frequency Selection – DFS
 - Pro-active cognitive approach - Signaling to other systems
 - Recognition of other systems
- **Inter-system communication**
 - Messages
 - Common Management System

● Common policies

- How to select a “free” channel (for ACS and DFS)
 - Acceptable $S/(N+I)$
 - Acceptable time occupancy
 - Capability of sharing the spectrum to implement a Shared Radio Resource policy
- Interference reduction policies
 - BS synchronization
 - Shared Radio Resource Management
 - Fairness criteria
 - Distributed scheduling, power control, bandwidth control, beam-forming

Initial P802.16h view of network



DRMM – Distributed Radio Resource Management

MIB – Management Information Base